

GP2 (Berkeley Grant Proposal Game): Mapping the Ennis Quadrangle

This game, as implied by the title, was developed at UC Berkeley sometime in the 1960's and 1970's. Versions of it exist in many campuses across the world. The purpose of the game is to summarize the earth materials and processes discussed in this course and incidentally to give you an idea of where science meets reality.

Introduction: You are a research group from another planet with technology very similar to late 20th century human technology. You have been briefed about Earth geology and are looking forward to applying that knowledge. A robot probe has mapped the Earth's surface and discovered something **anomalous** about the Ennis quadrangle in southwestern Montana. It sends back the posted map which shows areas (lettered) of different rocks and the topography, and just before it tells you what the anomaly is, it explodes. You have \$100,000 of "seed" money to spend as you see fit on proposals to further the research started by the brave little probe.

Scientific goals:

1. Figure out the geologic history of the Ennis quadrangle
2. Discover what the anomalous thing is.

Group goal: To gain more points (prestige) than other groups by generating successful grants and publishing more papers. These points, incidentally, count towards the 50 points possible in group project 2. There is a cap of 50 points for this project.

Setup: Form groups of four. Obtain a copy of the Ennis, Montana, topographic map; make sure that the lettered areas that the probe mapped are legible. The probe was able to distinguish that each lettered area is made of a single type of rock; no other information is known (apart from the surface features like rivers and lakes and contour lines). If these are unclear on the copy, please see the color copy pinned to the Journal board.

The play: Moves made be made continuously throughout the period. Legal moves are:

- **Submitting a grant proposal** on the proper form. The group name, a short description of the experiment to be done and the costs of the experiment are necessary ingredients for a valid proposal. The outcome of the proposal will be determined by the Grant Committee. **Funded** proposals will have the results of the experiment written on the back of the proposal form. **Unfunded** proposals will be returned to the group and may be reworked into another proposal.
- **Submitting a manuscript** for publication on the proper form. The group name and a short legible write-up (see below for different types) are necessary for a

valid manuscript. The outcome of the manuscript will be determined by the Journal Editor. Each journal has a set of editors that evaluate the manuscripts that are submitted to them. A manuscript will be accepted for publication only if it has significant new research and the evidence justifies the conclusions the authors reach. A published manuscript is called a **paper**, and will be posted on the Journal board in order of acceptance. *Everyone* may and should inspect the publications.

There are many types of papers: for convenience, we will consider two types only. The first is an **observation** paper; as the name implies, this paper will simply state or display an observation, with a minimum of interpretation of what the observation means. The other is a **theory** paper. Theory papers are those that have a hypothesis for which the authors provide ample evidence from *their own* research (published or not) or from *another group's published* research. A **citation** (the publications will be numbered in the order that they are received) to the number of the previously published paper is necessary.

Please see the examples on the next pages. Notice that, since theory papers score significantly more points than observation papers, they will be held to a higher standard of supporting evidence and citation.

A **rejected** manuscript does not have to be thrown out. Usually, the editors point out what was wrong with the manuscript, and therefore, it should be **revised** and resubmitted.

Scoring: As in life, you are rewarded for the completion of your project and for your publications. In life, your group gains prestige and getting proposals funded and papers published becomes easier. In this game, you get points:

Funded proposals	3 points
Observation paper published	2 points
Theory paper published	6 points
Citation of your paper by another group	1 point
Bequest to the museum	1 point

A maximum of fifty points will be given for this group project and all group members share the same final score.

Observations from previous Berkeley Grant Games:

- Groups which have neglected the Journal board have produced redundant manuscripts, which are summarily rejected.
- Publishing nothing but observation papers does not accrue very many points.
- Your group, of course, is the first group to see your particular results. This is probably a good time to **simultaneously** write a theory manuscript based on your results!
- Since the manuscripts are numbered consecutively as they are submitted, only the group which submitted its manuscript **first** will be published for that particular result.

- Don't ask for the identity of a rock sample unless you are absolutely desperate; it costs \$10,000 and a rejected paper (rejected because of misidentification) will cost you nothing. Heck, you may even *guess* the rock's identity correctly.

Experimental costs:

Ground surveys	
Rock samples (up to 3 lettered areas)	\$1,000 each
Identity of a rock sample	\$10,000
Identity of a fossil sample	\$5,000
Dating techniques (must specify specific item to be dated)	
Carbon-14	\$10,000
Potassium-Argon	\$10,000
Uranium-Thorium	\$10,000
Lichenometry	\$10,000
Seismic survey (must specify a line through map)	\$10,000
Gravity survey (must specify up to 3 adjacent lettered areas)	\$10,000

Other experimental costs are assessed on a case-by-case basis

To help you along, I've listed below 34 questions that should be answered in order to fulfill the project. Each of the questions is labelled "observation" or "theory"; the first correct response to any question is publishable and therefore worth points. Note that these are not the only topics on which you can submit papers!

Questions

(Observation)

0. Where does water flow off the map? (What is the low point?)
1. What is rock A?
2. What is rock B?
3. What is rock C?
4. What is rock D?
5. What is rock E?
6. What is rock F?
7. What is rock G?
8. What is rock H?
9. What is rock I?
10. What is rock J?
11. What is rock K?
12. What is rock L?
13. What is rock M?
14. What is rock N?
15. What is rock P?

16. What is rock Q?
17. What is rock R?
18. What is rock S?
19. Do fossils exist in any of the rocks?
20. Do any other noteworthy minerals exist in any of the rocks?
21. Do you have numerical or relative (period) dates on any of the rocks?
22. Do any other field methods reveal more observations?

(Theory)

23. Are there any faults on the map? Cite your evidence.
24. Are there any folds in the map? Cite your evidence.
25. Are there any types of metamorphism on the map? If so, where and how do you know?
26. Order the sedimentary layers from youngest to oldest. Cite your evidence.
27. Order the igneous, sedimentary and metamorphic events. Cite your evidence.
28. Order the rocks and faulting and folding events. Cite your evidence.
29. What sort of tectonic boundary is this area near? Cite your evidence.
29. Did the river's base level ever change? Cite your evidence.
30. Are there any mega-slides in this area? Cite your evidence.
31. Was this area ever glaciated? Cite your evidence.
32. What is the anomaly? Cite your evidence.
33. How did the anomaly affect the topography? Cite your evidence.

In addition to citing another group's data or your own, evidence may also consist of a **drawing of the appropriate part of the topo map** (along with an explanation).